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**U.S. ARMY BATTLE DAMAGE ASSESSMENT
OPERATIONS IN OPERATION DESERT STORM
VOLUME 1**

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SEPTEMBER 1992

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U.S. ARMY LABORATORY COMMAND

**BALLISTIC RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND**

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EXECUTIVE SUMMARY

In December 1990, the U.S. Army Ballistic Research Laboratory (BRL) was tasked to supply a battle damage assessment team to support Operation Desert Shield/Storm. The primary mission of the team was to conduct battle damage assessments of U.S. ground combat vehicles and immediately provide the information to the operational unit commanders. This information would thus provide them immediate feedback on the damage mechanisms responsible for the loss of their vehicles. Besides the combat intelligence value, it was anticipated that this information could then be used to make quick-fix vulnerability reduction design changes, possibly saving lives. The secondary mission was to gather technical damage assessment data for input into the live-fire testing database established at BRL. This information would then be used in vulnerability reduction design studies supporting various PMs/PEOs in their work of designing and building future Army combat vehicles.

The team was selected and trained at Aberdeen Proving Ground (APG), MD, and deployed to the Persian Gulf on 18 January 1991. Initially attached to the Army Materiel Command-Southwest Asia (AMC-SWA) in Dhahran, Saudi Arabia, the team was eventually successful in attaching itself to elements of the U.S. VII Corps, specifically the 1st Infantry Division. The team followed this unit from the first day of the ground offensive through the initial breaching operations, through Iraq, and finally into northern Kuwait.

The battle damage assessment team evaluated 48 vehicles damaged during ground operations. Many of the vehicles were evaluated on the battlefield where they were hit. The remainder were seen at various maintenance collection points in Saudi Arabia, Iraq, and Kuwait.

Because of the speed of the assault and the early cease fire, the primary mission of making quick fixes to vehicle designs/configurations disappeared. Another critical role developed, however, and that was in assisting unit commanders in identifying friendly fire incidents. The result of this work will not be discussed here. It can be found in a summarized report issued by the Army's Office of the Deputy Chief of Staff for Operations.

It was learned that detailed vulnerability evaluations cannot be expected from combat data due to a variety of reasons detailed in this report. This type of data could only be used to identify unusual damage mechanisms or unanticipated vehicle vulnerabilities for future controlled investigations.

The results of the battle damage assessments generally show that the Abrams Tank and Bradley Infantry Fighting Vehicle performed as expected, or in some cases better, in surviving impacts by a variety of threat munitions. No unexpected vehicle vulnerabilities were discovered.

It is hoped that this two volume report will serve as a guide for future combat damage assessment operations.

1. INTRODUCTION

In December 1990, the U.S. Army Ballistic Research Laboratory (BRL) was tasked to supply a battle damage assessment team to support Operation Desert Shield/Storm. The primary mission of this team was to document the damage inflicted on U.S. ground combat vehicles caused by threat munitions. This documentation would describe both the type of threat munitions which caused the damage and the operational status of the components and systems within each vehicle. Provided to the operational unit commanders, it would give them immediate feedback on the damage mechanisms responsible for the loss of their vehicles. Besides the combat intelligence value, it was anticipated that this information could then be used to make quick-fix vulnerability reduction design changes, possibly saving lives.

The secondary mission was to gather damage assessment data for input into the live- fire testing database established at BRL. This information would then be used to assist system engineers in identifying and correcting vulnerability flaws in the vehicle design.

This report will be in two volumes. This volume will discuss the operations conducted by the battle damage assessment team (BDAT) to accomplish this mission. The second volume will report on the technical damage assessments themselves.

2. BACKGROUND

The Vulnerability/Lethality Division (VLD) of BRL has the continuing mission to participate in live-fire testing of Army weapon systems. Live-fire testing involves actual firings of new weapon systems against realistic threat equipment as well as firings against U.S. systems. The purpose of such testing is to collect data on the lethality and the survivability of U.S. systems under realistic conditions.

A part of VLD's mission in live-fire testing is assessment, documentation, and analysis of the damage inflicted on targets. In connection with this mission, VLD has developed systematic procedures for inspecting and testing targets after each shot to assure that all damage which occurs is detected. These procedures are implemented in the field by means of checklists. The checklists are designed to lead the assessor through a systematic check of

all the systems functions. When a failure is detected, a procedure is available for identifying the specific damaged component(s). The checklists are prepared by engineers familiar with system design who make certain all vehicle systems and subsystems are addressed in the checklists.

The checklists for this operation were put together by the Systems Assessment Branch of VLD in a format compatible for input into the already-developed Information Collection and Reporting System (ICARS). In this way, the information contained in the checklists could be easily entered into the vulnerability database already established in BRL to support the Live Fire and Joint Live Fire Test Programs.

Analytical procedures have been developed which then translate the observed damage information, located in this database, into a quantitative measure of the degradation of the damaged vehicle's ability to perform a combat role. Design engineers would then use this information to recommend vehicle vulnerability reduction methods.

Many design recommendations to improve vehicle and crew survivability in combat have been made due to lessons learned in live-fire testing. The extreme cost of this testing, however, limits the number of tests which can be accomplished. It was felt that damage assessments of vehicles hit in combat would provide a unique and reasonably inexpensive opportunity to gather additional damage assessment data.

The mechanics of battle damage assessment under combat conditions are basically the same as damage assessments conducted during controlled testing. The intended use for the data is also basically the same, except the battle damage data also has some immediate utility to the field commanders. Because of VLD's experience in live-fire testing, much of the technical background for the battle damage assessment mission was already in place.

There are two significant technical problems in battle damage assessment that do not occur in controlled testing. In battle damage assessments, the attacking munition is not immediately known, nor is the operational condition of the vehicle prior to the attack known. It is possible to identify the attacking munition from the appearance of the impact signature and from information on the tactical background at the time of the impact. Understanding the

initial condition of the damaged vehicle is very difficult, even with crew support. This problem will be discussed later.

Preparations for this mission involved training inexperienced soldiers in well established techniques. The preparations also included logistical operations for performing damage assessments under combat conditions, with the understanding that little logistical support from outside units would be available once deployed.

3. NOTIFICATION

During the last week of November 1990, BRL was tasked by the Deputy Under Secretary of the Army (Operations Research) (DUSA-OR) to put together a tasking message requiring the formation of a BDAT. This message would go to the DUSA-OR for review/modifications and would then be forwarded to the Office of the Deputy Chief of Staff for Operations (ODCSOPS) for release. On 6 December 1990, this message, with minor changes, was sent from ODCSOPS as a task for implementation. Basically, BRL was given the mission to select, train, and deploy a BDAT for support of Operation Desert Shield. This team, comprised of military personnel only, would be prepared to deploy on order not later than 1 January 1991 (later extended by ODCSOPS to 5 January 1991). Due to communications delays, BRL did not receive the order until 11 December 1990, giving it 21 days for execution. Once notified for deployment, the BDAT would then have 48 hours to depart CONUS.

At 2145 hours, 16 January 1991, the BDAT team leader was notified by the AMC Emergency Operations Center to have his team ready to depart the next day. The team was assembled with all of its required equipment by 0600 hours 17 January. A weapons problem, which will be discussed later in this report, delayed departure to 1530 hours—approximately 18 hours after notification.

A subsequent weapons draw was conducted the next morning at Fort Belvoir, VA. The weapons were then test fired and issued to each individual. The team departed for Dover Air Force Base at 1800 hours 18 January 1991, finally arriving in Dhahran, Saudi Arabia 0800 hours, 21 January.

4. CONUS PREPARATIONS

4.1 Personnel. Due to the short suspense of the mission, it was decided that the selection of personnel for the BDAT would have to be made from local (Aberdeen Proving Ground, MD) units, preferably from volunteers only. Each of these volunteers would then have to attend the mandatory Processing for Overseas Reassignment (POR). The only available POR dates which would fit with the 1 January 1991 deadline began on 15 December 1991, thus BRL had three days to finalize team selection.

Various commands located at Aberdeen Proving Ground were visited and apprised of the BDAT mission and short suspense to prepare the team for deployment. From these visits, there was one volunteer from the U.S. Army Human Engineering Laboratory, three from the U.S. Army Combat Systems Test Activity, four from the U.S. Army Ordnance Center and School, and four from BRL. One member from the Combat Systems Test Activity eventually dropped out from the training, and another member from BRL was added after deployment. This addition will be discussed later. The rank structure of the final 12 man team was 2 majors, 2 master sergeants, 2 sergeants first class, and 6 staff sergeants. One of the majors served as the officer-in-charge (OIC) and one of the master sergeants served as the non-commissioned-officer-in-charge (NCOIC). The list of team members and their parent units is provided in Table 1.

Requests for additional personnel were forwarded to both the U.S. Army Armor Center and School and the U.S. Army Tank Automotive Command, but neither organization had the resources to participate. The chief of the Systems Assessment Branch, VLD, BRL was the first-line supervisor of the BDAT. He later became the team's primary point of contact for all CONUS communications/coordination.

All BDAT personnel were required to be "read on" to various Special Access Programs (SAPs) due to the possibility of the team's exposure to security situations covered under these programs. This security measure was handled through the BRL Security Office.

Due to the "be prepared" nature of the mission, it was decided that personnel would be attached to BRL only after the actual order to deploy was received. BRL then cut TDY orders

Table 1. Battle Damage Assessment Team

Rank	NAME	UNIT
MAJ	R. Koffinke	U.S. Army Ballistic Research Laboratory
MAJ	C. McCoy	U.S. Army Ballistic Research Laboratory
MSG	E. Braese	U.S. Army Ballistic Research Laboratory
MSG	R. Raby	U.S. Army Ballistic Research Laboratory
SFC	K. Accord	U.S. Army Human Engineering Laboratory
SFC	J. Holmes	U.S. Army Ballistic Research Laboratory
SSG	J. Altmeyer	U.S. Army Combat Systems Test Activity
SSG	J. Davis	U.S. Army Ordnance Center and School
SSG	D. Guiles	U.S. Army Combat Systems Test Activity
SSG	J. Moore	U.S. Army Ordnance Center and School
SSG	W. Payson	U.S. Army Ordnance Center and School
SSG	W. Sanders	U.S. Army Ordnance Center and School

for all personnel for deployment. BDAT members remained with their units for duty except during the necessary damage assessment training. All orders were prepared in advance with everything completed on these orders except the date of execution.

4.2 Training. The training for the BDAT was broken down into three separate phases. The first phase consisted of the required five-day POR conducted at Aberdeen Proving Ground (APG) from 17 through 21 December 1990. This training was set up and run by APG for all deploying personnel from the Army Materiel Command (AMC) and units assigned to APG. Besides the regular records checks and audits done for all PORs, training in desert living and culture, NBC refresher training, and enemy characteristics and traits were also covered.

The second phase consisted of vehicle familiarization training. There were five U.S. ground systems of interest for the collection of battle damage information. These systems were the Abrams Tank, the Bradley Fighting Vehicle, the Sheridan Armored Airborne Assault Reconnaissance Vehicle, the M60-Series Tank, and the USMC LAV-25. Each BDAT member

had experience on one or two of the systems, but none were familiar with all of them. For the level of the damage assessments planned, at least an operator-level knowledge on each system would be required. Thus, it was necessary to train to this level on each of the systems. This training was conducted with the assistance of the Ordnance School using their instructors and equipment. Training on all five of the vehicles was completed by 3 January 1991.

The last phase of the BDAT training consisted of battle damage assessment training. Fortunately, several members of the team had experience in live-fire testing; therefore, they had a good grasp of what was required when assessing damaged vehicles. These members served as the core instructors for the majority of this training phase. Four general areas of instruction were given.

First, methods of identifying types of munitions by their signatures were studied. Since the weapon causing the damage would not be known in most cases, it was felt this would be a critical piece of information for unit commanders, besides being necessary in the vulnerability evaluation process.

Armor design and configurations of the five vehicles were studied. This was required to better identify and evaluate armor package performance on the battlefield. Also included in this portion was the handling of radiation monitoring equipment, monitoring and protection procedures, and decontamination procedures.

Live-fire test reports and videos were reviewed. This gave the BDAT members a much better feeling for the amount and type of detail which is required in evaluating damaged vehicles.

Finally, a practical exercise was conducted on a vehicle damaged during a live-fire test. This exercise was conducted at a range belonging to the Combat Systems Test Activity.

One additional item that needs to be mentioned is the discussions held with a member of a previous damage assessment team the Army had fielded. This team was operational in

1973 and had performed damage assessments on vehicles from the Arab-Israeli conflict. The lessons learned from this interview proved invaluable to team preparations and organization.

4.3 Logistics. The philosophy of the BDAT operations was that support from other units/organizations in the Kuwait Theater of Operations (KTO) would be nonexistent. Therefore, a logistics package was put together that allowed the team to be as self-sufficient and mobile as possible.

Rucksacks, flight bags, web gear, and other items of personal equipment not normally issued to soldiers in a TDA unit were requisitioned and distributed. Each team member was allowed a rucksack, a duffle bag, and a flight bag for all personal equipment. In addition, three 4-ft by 3-ft by 3-ft footlockers were constructed by the BRL shops to carry damage assessment equipment. Some equipment which could not be procured quick enough was provided through the assistance of the Maryland Army National Guard.

Damage assessment equipment was kept as simple and as maintenance free as possible. No computer equipment nor automated data collection equipment was taken. Photo equipment, radiation monitoring equipment, and small system test sets, with backups, were taken. The small system test sets were designed and built to assist in vehicle diagnostics. Special tools for measuring striking obliquity were taken. These tools were designed and built by the BRL shops. A partial list of supply items which needed to be purchased is provided in Table 2.

The bulk of the equipment was in the form of technical manuals and the damage assessment checklists. It was not known if the reproduction of documents would be possible once in the KTO, so enough checklists and manuals had to be taken based on an estimate of total needs. In addition, it was felt that some, if not all, of the damage assessment information would be of sufficient time-critical value to warrant a quick return to BRL for analysis. Therefore, prestamped and addressed envelopes were also taken to expedite shipping. It was planned that as each assessment was completed, all documentation and film would be placed in an envelope and immediately forwarded through Army channels for delivery to BRL.

Table 2. Supply List

QUANTITY	ITEM
3 each	Nikon N6000 35-mm cameras
3 each	Polaroid Spectra System Pro Cameras
3 each	Nikon 35-75-mm zoom lenses
3 each	Camera cases
3 each	Nikon SB23 strobes
100 blocks	35-mm film
100 packs	Spectra (Polaroid) film
22 each	lithium batteries
3 each	azimuth protractors
144 each	marker pens
25 pair	heavy duty work gloves
3 each	tool kits (vice grips, screwdrivers, knives, etc.)
3 each	first aid kits
3 cases	flashlight batteries
12 each	map and photography cases
12 each	kit bags
12 each	rucksacks
3 each	footlockers, 3 ft x 3 ft x 4 ft

The availability of weapons for team members was coordinated through AMC for issue prior to deployment because it was not known if and when weapons would be issued in the KTO. The weapons were picked up for issue on the day scheduled for deployment. However, they appeared to be in such poor condition that it was decided to test fire them prior to departure. Only 4 of the 11 weapons drawn functioned properly and departure had to be delayed 24 hours until substitute weapons could be found. Through the assistance of the Ordnance School, arrangements were made to draw eleven M16A1s from a unit located at Fort Belvoir, VA. This was accomplished and the weapons were test fired on the day of departure.

No arrangements for pay, mail, or other means of communication could be made due to the lack of coordination within the KTO prior to departure.

4.4 Coordination With Other Agencies/Units. This area of preparation proved to be the most difficult and frustrating in the predeployment process. Initial coordination with the tasking agency (ODCSOPS) to arrange for support within the KTO after deployment was accomplished on 12 December. The instructions at that time were that AMC would set up all KTO support and unit coordination. Specific questions that needed to be answered rested around team logistical support (barracks, transportation, mess, etc.) and chain of command requirements (who would the team report to, battlefield placement, unit coordination, medical evacuation, etc.).

These support issues were forwarded to the AMC Desert Shield Office through BRL's higher headquarters, U.S. Army Laboratory Command (LABCOM), on 13 December 1991. No specific guidance on any of these issues was obtained. It was not until 2 hours before the team's departure on 18 January 1991 that any coordinating instructions were received. The entire guidance for KTO support consisted of a phone number to call for the AMC Southwest Asia (AMC-SWA) office, and a promise that this office would take care of all requirements once the team had arrived in Dhahran.

During this period of preparation, several updates were written and forwarded through the BRL chain of command. Copies of these official updates are given in the Appendix.

5. OCONUS PREPARATIONS

Most of the OCONUS preparations were conducted in and around the BDAT's base camp co-located with the AMC-SWA office in Dhahran, Saudi Arabia. These preparations were conducted prior to the BDAT deployment forward to VII Corps on 20 February 1991.

5.1 Personnel. Upon arrival in Dhahran, Saudi Arabia, the BDAT was assigned to AMC-SWA. All personnel actions and accountability were handled through that office.

It was during the pre-ground war phase that an additional member joined the BDAT. A master sergeant from BRL with extensive damage assessment experience had been sent TDY with the 24th Infantry Division in August 1990. According to regulations, any member sent TDY to fill a vacancy in one unit was authorized to return to his parent unit should that parent unit be subsequently deployed. Since this was the case with BRL, a laborious series of orders and counterorders were then drawn up to reclaim this individual. A segment of the BDAT departed on 17 February 1991 from Dhahran to King Khalid Military City (KKMC), Saudi Arabia, a trip of approximately 7 hours, to attempt to reclaim the master sergeant. This mission was accomplished and this section of the BDAT linked up with the rest of the team in Iraq on 25 February 1991.

Mail was handled through the offices of AMC-SWA. However, once the BDAT deployed forward with VII Corps, it was decided that all incoming mail and communications would need to be held at AMC-SWA's KKMC office. It was felt that the BDAT operations would cover large distances and attachments to several units. Therefore, it would be highly unlikely that mail could catch up. This proved to be accurate but painful, as the BDAT was out of communication for several weeks.

The chain-of-command for BDAT operations while in the KTO was never clear until after its return from Iraq and Kuwait. The commander of AMC-SWA understood his position to be one of support only, with no operational control nor responsibility. A representative from ODCSOPS, who was serving in Dhahran in another capacity, attempted to claim control. This proved to be unworkable for all concerned. Coordination through Army Central Command (ARCENT) also proved futile. Eventually, the BDAT worked independently within the guidelines of its mission statement. It coordinated with the units it would support as it became necessary or as the team passed through its area of operation.

After the return of the team from Iraq in mid-March 1991, the BDAT came under the control of the recently deployed Weapon System Combat Performance Assessment Team (WSCPAT), a data collection effort sent from AMC. This chain-of-command association proved successful in the support of subsequent BDAT operations.

5.2 Training. Most of the training had been completed prior to deployment. However, several areas did need additional emphasis prior to actual operations.

No time had been allotted to individual weapons training other than familiarization firing while at home station. Ammunition was procured and a range area was found where team members could spend additional time in weapons firing and zeroing.

LORAN navigational equipment was procured and its use as well as some desert navigation training was conducted. This training proved to be essential to basic survival in future operations.

Vehicles were supplied to the BDAT in late January 1991. The operations and maintenance of these vehicles consumed a large amount of the training time.

5.3 Logistics. As previously mentioned, AMC-SWA had the logistical support responsibility for BDAT operations. This responsibility included providing billets, mess, vehicles, and additional equipment to team members. Not all of the required equipment, however, could be provided, and in this regard other sources of supply were tapped by resourceful BDAT members.

Four High Mobility Multi-purpose Wheeled Vehicles (HMMWV) were issued—two of the four-seat design, and two of the two-seat design. These were picked up on 25 January 1991. Prior to that date, transportation was provided in the form of rental vehicles on loan to AMC-SWA and subsequently loaned out to BDAT members as needed.

Billeting, while assigned in the Dhahran area, was located in the Khobar Towers. This facility served as a processing area for the majority of U.S. Army troops. Tents or vehicles were used once the team moved from Dhahran.

Mess facilities were located throughout Dhahran and Khobar Towers, most without unit affiliation requirements. Meals Ready to Eat (MREs) could be procured at many of these facilities or through AMC-SWA for bulk issue. Water was also procured through AMC-SWA.

Once the ground war started, the units which the BDAT was supporting generously supplied whatever food and water they had available.

Additional items of equipment essential to desert and combat survival were acquired through various sources of supply. Radios, mounts, and secure devices were all acquired through the AMC supply point. Tents, NBC monitoring equipment, additional uniforms, and personal items were acquired. LORAN navigational equipment was located and signed for through ARCENT headquarters. Ammunition, additional MREs, bottled water, and medical supplies were acquired and stockpiled for future use.

5.4 Coordination With Other Agencies/Units. It became immediately apparent that no one in the KTO, except the commander of AMC-SWA, knew of the BDAT requirements or mission. No coordination had been made for battlefield operations nor for unit attachments and support. It was left entirely up to the team to coordinate for its operations in the KTO to insure its mission was accomplished.

The first step in doing this was to initiate contacts with personal acquaintances on the XVIII and VII Corps staffs. This then opened the door to gaining acceptance for subsequent support and positioning prior to the beginning of the ground offensive.

Coordination began on 23 January 1991 with a visit to the XVIII Corps Tactical Operations Center (TOC), located at that time in the general vicinity of Dhahran. Through a personal contact on the Corps staff, meetings were conducted with representatives of the G-4 (Logistics) and G-3 (Operations) sections. This was the first occasion in which the BDAT was made aware of the upcoming Desert Storm ground offensive plan. At these meetings, the mission of the BDAT was explained, as were the benefits which could be gained by the unit commanders in having a damage assessment capability within their control. The main selling point which BDAT members had to emphasize was that they could provide a service which, to the unit commanders, was another combat multiplier, and this service was inexpensive to the unit commander. The only support requirements the BDAT would have would be for battlefield location clearance, some food and water support, and a means of establishing communications to the rear in case critical information was deemed necessary for immediate dissemination.

XVIII Corps representatives were supportive of the idea, but felt VII Corps would be the better location due to its planned armor-heavy fight. The BDAT could cover XVIII Corps areas of operation after completing VII Corps. Arrangements were made for XVIII Corps to contact BDAT assets through AMC-SWA should there be a requirement for an earlier link-up.

Another personal contact cleared the way for a visit to the VII Corps TOC on 24 and 25 January 1991. At that time, VII Corps TOC was located in the vicinity of Hafar Al Batin, approximately 300 miles west of Dhahran. Meetings were eventually held with the G-3 (Plans), the G-4 (Logistics), the G-2 (Intelligence), and finally the Corps Chief of Staff. After discussing the same points as had been discussed the previous day at XVIII Corps, the Chief of Staff requested that the BDAT accompany VII Corps in the upcoming ground offensive. The Chief of Staff accepted responsibility for insuring the proper coordination and support would be provided. The BDAT would remain in Dhahran until just prior to the ground offensive. It would then be called forward at a time and place selected by the Chief of Staff. The BDAT was eventually called forward to link-up with the advanced elements of VII Corps on 20 February 1991. This link-up and subsequent operations will be discussed later in this report.

Once the coordination for combat operations had been made, it was felt that coordination with ARCENT should also be completed. Attempts to make this coordination through LACOM/AMC channels were unsuccessful. Therefore, again using personal contacts, discussions occurred with representatives in the ARCENT G-3 (Force Modernization) section. From there, meetings were setup with the G-3 (Plans) for final approval of BDAT operations. This meeting was held at ARCENT headquarters in Riyadh, Saudi Arabia, on 15 February 1991. Discussions concerning BDAT mission and capabilities, the same as were conducted at the two corps, were held. The plan for BDAT operations centering initially in the VII Corps area of operation was approved. As a result of this meeting, ARCENT headquarters sent out correspondence to both corps commanders and staffs that BDAT operations would be supported to the best extent possible. This message proved critical in supporting BDAT coordination in future operations with units unfamiliar with damage assessment operations and priorities.

Prior to the beginning of the ground offensive, it was felt that damage assessments of foreign and enemy equipment would also be an option. To insure proper coordination of this optional mission, it was decided that contact would need to be made with the Foreign Military Intelligence Battalion (FMIB), then located in the vicinity of Dhahran. This meeting took place on 12 February 1991. It was decided between the BDAT and FMIB representatives that their respective missions would not interfere with each other, but that communications would be maintained between the two organizations.

During the stay in the Dhahran area, telephone communications were maintained with BRL through the offices of AMC-SWA. In addition, a computer site located in the former U.S. Army Liaison Mission compound in Dhahran was used for electronic mail communications. Through these lines of communication, AMC/LABCOM notified the BDAT of damaged Marine Corps vehicles and the point of contact in the Marine Corps Research and Development Command (MCRADEC) for coordination of their damage assessment. The BDAT made contact with MCRADEC representatives and travelled to their offices located at the port of Al Jabayl, anticipating being passed forward to conduct the assessments. This move occurred on 8 February 1991. However, the final move to the site of the damaged vehicles was not approved, and the BDAT representatives returned to Dhahran. This was the only contact made with the Marines until the team's return to Dhahran in late March.

6. BATTLEFIELD OPERATIONS

The BDAT was called forward to join VII Corps, departing its Dhahran base camp, on 20 February 1991. The team at this time was minus one vehicle and three individuals who had left earlier to pick up an additional team member. The team linked up with the VII Corps main TOC located on the Al Qaysumah air base.

On 21 February 1991, the team conducted the first of its damage assessments on vehicles belonging to the 1st Cavalry Division. The specifics of all of the damage assessments will be covered in Volume II of this report. These vehicles were assessed at a maintenance collection point after having been damaged during a border skirmish with Iraqi forces, prior to the actual ground offensive.

It was decided by VII Corps that the BDAT would accompany elements of the Division Support Command (DISCOM) of the 1st Infantry Division to better position it for the anticipated armor-heavy fight at the breach of the Iraqi lines. The team moved from its Al Qaysumah base, linked up with DISCOM elements on 23 February 1991, and crossed the berm into Iraq on 24 February 1991. For the next several days, the team did nothing except follow in convoy with the unit it was attached to, as the 1st Infantry proceeded north, and then east into Kuwait. No reports of damaged vehicles nor requests for support were received. On 25 February 1991, the one vehicle and now four individuals missing from the original move to Al Qaysumah linked up with the rest of the team in Iraq. The LORAN navigational equipment was proving itself invaluable.

No information was received on damaged vehicles for the first three days of the ground offensive. Direct communications with VII corps had been lost due to the extreme distances covered. It was decided that a portion of the team would be sent back to the VII Corps and the DISCOM's of the other divisions to coordinate for the damage assessments. This segment of the team departed on the night of 26 February 1991 to carry out this coordination. The rest of the team continued to follow in the path of the 1st Infantry DISCOM. The route taken was north through the breach into Iraq and then east into Kuwait. At the cessation of hostilities, the team established a base camp within the 1st Infantry DISCOM located along the Kuwait City/Basrah highway in northern Kuwait.

Late in the evening of 27 February 1991, the team was told to be prepared to send a representative the next day to conduct a preliminary assessment and a radiation check on several damaged vehicles. Due to the lack of technical expertise in the area of depleted uranium armor and bullets within the operational units, the Assistant Division Commander (ADC) requested the BDAT to assist in crew evacuation and in evaluating the radiation dangers which he felt were present in the damaged vehicles. On 28 February 1991, a BDAT representative, accompanied by the ADC and the brigade commander of that unit, was airlifted to the site of an earlier armor engagement to conduct this initial assessment and to assist in the crew evacuation. Given the amount of radiation present at the impact points on the damaged vehicles, it was determined that the vehicles had been hit by friendly fire. This first assessment set the stage for the BDAT's add-on mission of assisting in the investigation of friendly fire incidents.

After returning from this initial assessment, coordination was made for the entire BDAT (minus the section which had returned to VII Corps) to return to the site. On 1 March 1991, escorted by a mech infantry platoon and a recovery team, the BDAT moved out to begin the assessment of 1st Infantry Division vehicles. Those vehicles which could be found were assessed and the team returned to its base camp in northern Kuwait on 4 March 1991. At that time, link-up was made with the other section just returned from its coordination mission. That mission had been a complete success with points of contact, vehicle identifications, and grid locations established for both the 3rd and 1st Armored Divisions.

It was decided that the team would divide itself in half with one half covering the 1st Armored Division area and the other the 3rd Armored Division area. The plan was for each section to completely cover all of the vehicles in its assigned area and then to fall back into the AMC-SWA base at KKMC. It was learned that KKMC would be the collection point for all battle damaged equipment, and it was felt that those vehicles not found on the battlefield would eventually show up there and could be subsequently evaluated. Each section took two vehicles and its share of the damage assessment and survival equipment. A photo of a typical damage assessment operation is shown in Figure 1. In addition, a typical team base camp setup is shown in Figure 2. Each section moved out to its assigned area on the evening of 4 March 1991.

A typical damage assessment operation consisted of an initial coordination meeting with DISCOM representatives, and then a move to a lower echelon unit for pinpointing vehicle locations and points of contact. Actually finding the vehicles to conduct an assessment could sometimes take days. In some cases, the BDAT would have to coordinate for combat unit escort and support. Unreported vehicles were also found, and the information on these would be passed on to the appropriate unit for recovery action. All moves had to be coordinated with the unit maintaining control for that area. This was to avoid mines, enemy pockets of resistance, and any other obstacles inherent in a battlefield environment.

It was during this time that attempts were made to assess the damage to Iraqi equipment. Three factors led to the abandonment of this optional part of the mission. First, the danger involved with climbing over destroyed enemy equipment which had not been cleared of ammunition was too great a risk. In fact, on two separate occasions, enemy equipment

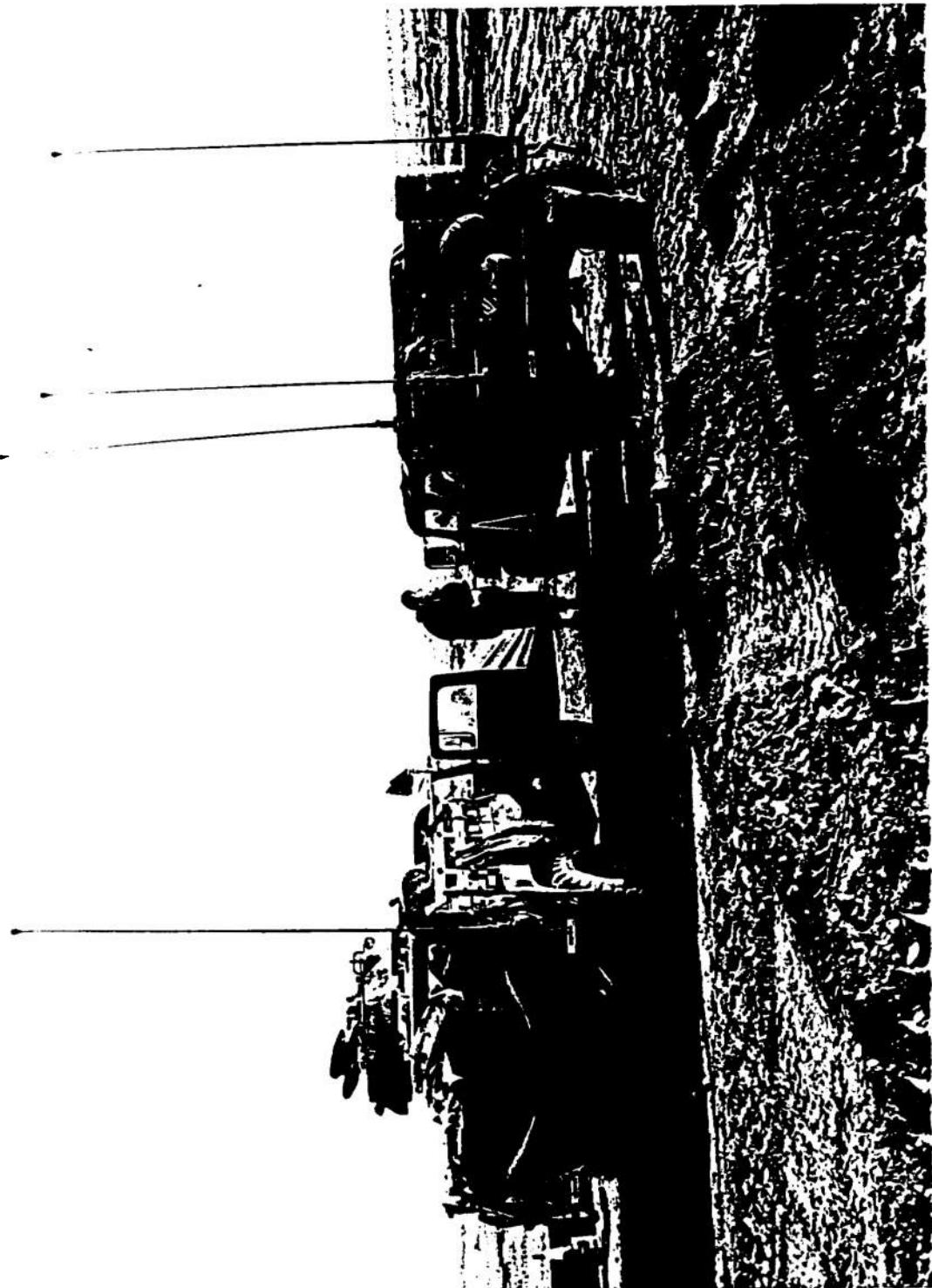


Figure 1. BDAT Assessment Operation, Iraq.

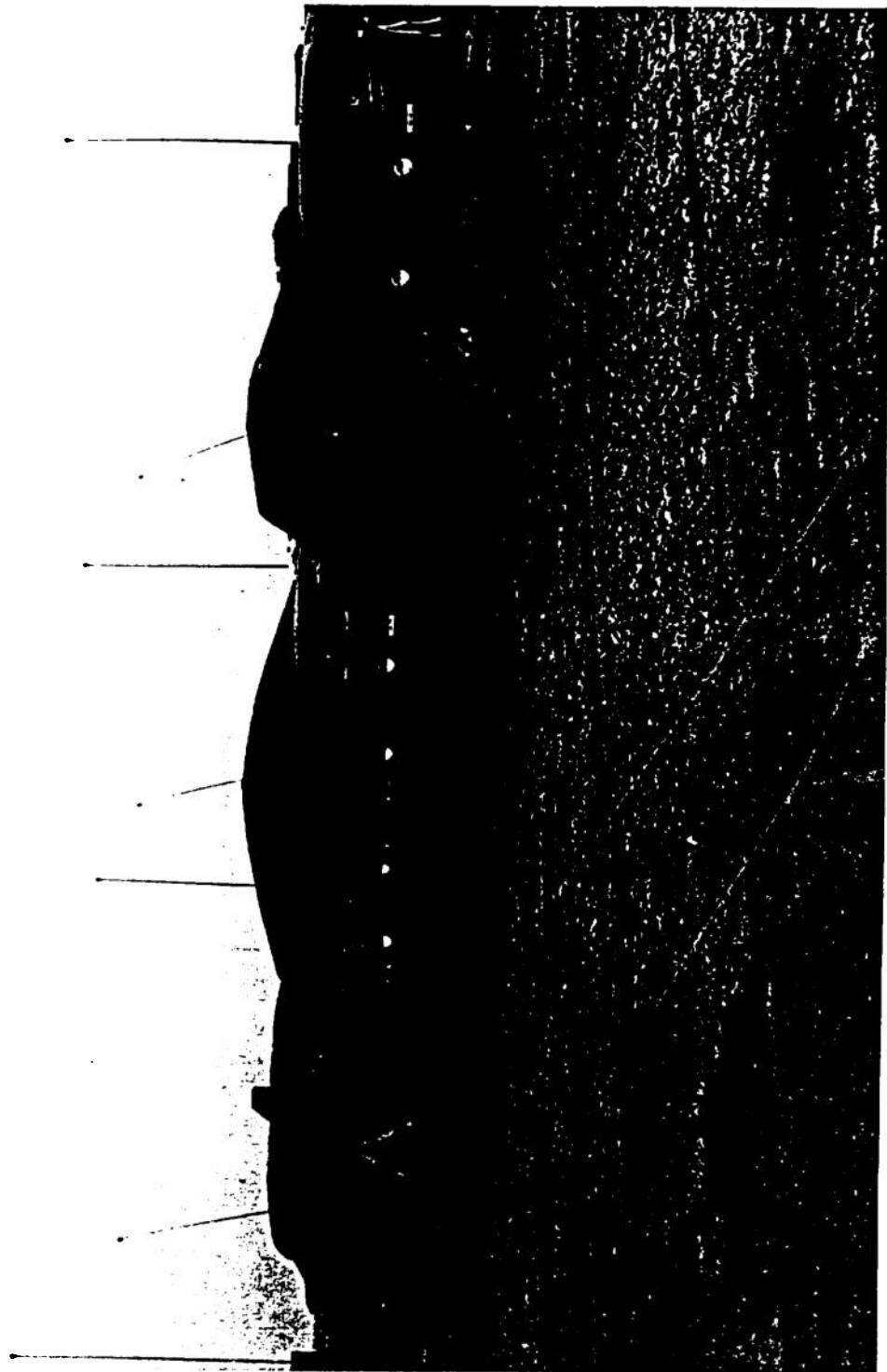


Figure 2. BDAT Base Camp, Iraq, 25 February 1991.

exploded in close proximity to assessment operations. Only good luck saved team members who were caught in the open when this happened.

Second, prior to the ground offensive, ARCENT had ordered that all Iraqi equipment be demilitarized whenever it was encountered. No one at that time knew how long coalition forces would be able to remain in Iraq and Kuwait. The opportunity for Iraq to reclaim repairable equipment had to be eliminated. Thus, the majority of Iraqi equipment was engaged multiple times, both during and after the cease fire. Determining primary defeat mechanisms, the most critical piece of information for damage assessment purposes, was virtually impossible given these conditions.

Third, it was felt that none of the equipment in the Iraqi arsenal was of sufficient intelligence value to justify an assessment of its vulnerability at the risk of the safety of team members.

Another mission relating to Iraqi capabilities was given to the BDAT by the BRL Foreign Intelligence Office (FIO). There were specific pieces of Iraqi equipment which FIO considered of critical intelligence value. They felt it would be worth the effort to have the BDAT try to capture this equipment for exploitation purposes. The difficulty in acquiring this equipment was in snatching it from the Iraqi forces prior to their being able to destroy it—if it had not already been destroyed by Coalition forces. The BDAT was successful in this mission and the equipment was carried back to BRL for subsequent exploitation.

Assessments were completed for the 1st and 3rd Armored Divisions, and the last section of the BDAT closed on KKMC on 11 March 1991. At this time, communication was re-established with BRL via telephone for the first time since 19 February 1991. Electronic mail was also established via a VII Corps link. It was upon the arrival at KKMC that it was learned of the BDAT attachment to the Weapon System Combat Performance Assessment Team (WSCPAT). The commander of this team allowed the BDAT the independence to complete its mission without the burden of additional WSCPAT missions, much to the relief of BDAT members.

The initial damage assessments carried in to KKMC indicated many cases of radiation contamination in damaged vehicles. Due to this, the BDAT coordinated with representatives of the Army Munitions and Chemical Command (AMCCOM) at KKMC. AMCCOM had the mission of the decontamination of all of these vehicles. A decon team from AMCCOM was subsequently deployed to the KTO to accomplish this task.

Contact was made with XVIII Corps on 14 March 1991 and a section of the BDAT moved out to assess that corps' vehicles. All of the XVIII Corps vehicles which were battle damaged had been consolidated at a Corps collection point located approximately 4 hours north of KKMC. These assessments were completed and the section returned to KKMC on 17 March.

While this section was with the XVIII Corps, the remainder of the BDAT was completing its assessments on vehicles not previously seen which were located in the collection point at KKMC. These assessments were also completed on 17 March 1991.

Once there was confirmation through each of the corps that all of the damaged vehicles had been assessed, the team, minus the OIC, redeployed back to its base in Dhahran. This move occurred on 19 March 1991. The OIC remained behind in KKMC to outbrief the operational units.

Through its new command relationship with the WSCPAT, the BDAT was able to make contact with Marine Corps representatives and coordinated for the assessment of their battle damaged vehicles. The BDAT moved from its base in Dhahran to the Marine Corps collection point in Kuwait and conducted assessments on all available Marine vehicles. This action was completed on 21 March 1991.

7. CLEARING OPERATIONS AND OUTBRIEFINGS

The sensitivity of the BDAT findings in relation to friendly fire incidents was already being felt at AMC-SWA when the BDAT first returned to KKMC. BDAT procedures and operations came under intense scrutiny for technical expertise as well as operational conformity. It turned out that this scrutiny would continue for months. No discrepancies were found. Subsequently, the BDAT OIC was summoned to report to the VII Corps commander in Iraq to

brief the initial findings. This occurred on 13 March 1991. The commander's instructions at this time included: no damage assessment information on VII Corps vehicles would leave the VII Corps without passing through him first; BDAT access to all damaged VII Corps vehicles would be guaranteed; and all division/regiment commanders would be personally briefed on the assessments of their vehicles. It was decided that to maintain consistency in assessment briefings, the BDAT OIC would conduct all briefings. As a result of these instructions, the original plan of forwarding assessment reports to BRL as they were completed was abandoned.

To insure the accuracy of assessment findings, daily coordination was maintained with representatives of VII Corps. All efforts were made to insure the accuracy of BDAT and Corps battle damage reports.

Division/regiment commanders and the VII Corps chief of staff were later briefed on the BDAT findings of their equipment. In some cases, brigade, squadron, and battalion commanders were also briefed (if they could be contacted and if the division/regiment commander requested it). Once these briefings were concluded, the corps commander was briefed. This took place at the VII Corps forward TOC on 19 March 1991. By that time, the corps commander had received guidance from the ARCENT commander not to allow release of the assessment information outside of the KTO until it had been cleared by ARCENT. At this time, however, the corps commander cleared the release of the information for outside of VII Corps and indicated he would recommend to ARCENT that the information be released from the KTO. This recommendation came only after the corps commander had been convinced that the handling of the information, once released from the KTO, would be in strict accordance with its sensitivity.

Once cleared from the VII Corps area, the XVIII Corps was contacted. The chief of staff of the XVIII Corps was briefed on 27 March 1991 on the results of the damage assessments conducted on XVIII Corps vehicles. Already aware of the content of the assessment information and of the ARCENT requirement for final approval, the chief of staff cleared the release of the information for outside of XVIII Corps.

The G-3 (Operations) for ARCENT was briefed on all of the Army damage assessments on 30 March 1991. He issued verbal approval for release of the information outside of the KTO, again, only after he had been convinced that the proper channels would be used in the subsequent release and handling of this sensitive information. Since the redeployment of the team was imminent, it was decided not to ship the damage assessment paperwork to BRL, but to hand-carry it back. This became the responsibility of the OIC. Courier orders were faxed into ARCENT from the BRL Security Office to allow the transportation of these documents.

Marine Corps damage assessment results were passed on to the Marine equivalent of the Army's Weapon System Combat Performance Assessment Team. This occurred in Dhahran on 2 April 1991.

While these outbriefing operations were going on, the majority of the team was preparing for redeployment back to CONUS. There was initially some confusion about the team's mission once it became attached to the WSCPAT and its original mission had been completed. The commander of WSCPAT, lacking specific guidance from AMC, decided to allow the redeployment of half of the BDAT. The other half was kept on call in Dhahran due to threats of additional engagements in Iraq which could require damage assessment support. This half of the team redeployed through the Dhahran offices of AMC-SWA and arrived back in CONUS on 29 March 1991.

The other half of the team, minus the OIC who had to complete the outbriefing requirement, was allowed to out-process a couple of days later. They arrived back in CONUS on 3 April 1991.

One other ongoing mission which had not been closed out was the decontamination of damaged vehicles by AMCCOM, described earlier in this report. To insure all contaminated vehicles had been checked, the BDAT OIC was required to return to KKMC to link-up with the AMCCOM team. Both teams compared their findings. In all cases, initial BDAT findings coincided with the AMCCOM team's findings. The OIC was then allowed to return to Dhahran to begin out-processing. He arrived back in CONUS on 10 April 1991.

8. RESULTS/CONCLUSIONS

The findings of the BDAT were subsequently used to support two major initiatives. The first was to aid in the Army investigation into friendly fire incidents. The BDAT information, standing by itself, could not answer all of the questions concerning what actually happened to each damaged vehicle. The information was, however, an important part of the whole story. Once combined with the intelligence information, the operational situation, and the casualty reports, a better picture of each damage incident was developed.

From its return in April until September 1991, the damage assessment information was used exclusively as part of this ongoing investigation. As such, the highest levels of Army and Department of Defense leadership were briefed by BRL on the BDAT results. Working in conjunction with the ODCSOPS during this time, BRL was a primary participant in all of the investigation proceedings.

As a result of this work, a final determination of friendly fire casualties was publicly released by the Army in late August 1991. Secondly, task forces were established in both AMC and the Training and Doctrine Commands (TRADOC) to recommend both operational and equipment fixes to lessen the possibility of friendly fire engagements in future conflicts.

The second major initiative which the BDAT information supported was that for which it was originally intended—to suggest ways to reduce the vulnerability of Army ground vehicles against threat munitions. Information from each damage assessment was used to detect unexpected or surprising occurrences of damage to each of the impacted vehicles. This information supplements that which was collected during live-fire testing. This will be covered in more depth in Volume II of this report.

Several lessons were learned concerning the conduct of damage assessment operations in a combat environment. First, any form of data collecting which needs to be done cannot be accomplished unless it also provides a service to the supporting unit. The BDAT learned that any references made towards the value of the information for future designs or databases were ignored. The unit commanders, rightly so, were only interested in how the BDAT services could help them in their conduct of the war. Also, the support which the unit

commanders had to supply to support BDAT efforts had to be very inexpensive. His resources were tied to his own mission, and he, again rightly so, was hesitant to share those resources unless the payback to his mission justified it. The bottom line is that data collection operations have to provide a service to the operational unit and they have to be as self-sufficient as possible.

The rank structure of the team was satisfactory. A field grade officer OIC was a good requirement due to the required coordination with varied headquarters and staff elements. The bulk of the team consisting of experienced non-commissioned officers allowed for the independence of operations which was necessary throughout the war.

Team size for individual assessments was adequate. Normally, assessments were conducted on a single vehicle by a section of six men and would require approximately 2 hours per vehicle. The distances which needed to be covered by the two six-man sections did not allow for timely assessments on all vehicles. Depending on the value given to damage assessment information, additional six-man sections positioned in units below corps-level may be an option to be reviewed for future conflicts.

The psychological impact on damage assessment team members needs to be considered in future combat operations. The mission requires members to work in the close confines of armored vehicles which have recently been damaged and, in almost all cases, have sustained significant crew losses. In some cases, crew evacuation became part of the assessment operation. Descriptions of the inside of these crew areas is not required. Rotation of team members' duties and even rotation of team members may be required in future operations requiring many assessments.

Coordination with operational units prior to deployment was not conducted. This must be a requirement in future operations, both for the safety of the team and for the guaranteed success of the mission. In addition, chains of command need to be in place and understood prior to deployment.

Another lesson learned here was the same as that learned from the damage assessments conducted in 1973. The format and eventual use of the collected information needs to be well

planned. Agencies which are anticipated recipients of the data need to be contacted for their input as well as the input from the operating agency.

Finally, detailed vulnerability evaluations cannot be expected from combat data. However, it is possible to identify unusual damage mechanisms or unanticipated vehicle vulnerabilities for design modifications and/or future investigations.

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**APPENDIX:
OFFICIAL UPDATES**

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SLCBR-VL-S (70-ly)

13 December 1990

MEMORANDUM FOR Director, U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground, MD 21005-5066

SUBJECT: Desert Shield Support

1. On Tuesday, 11 December 1990, BRL received a classified TWX describing requirements to support a Desert Shield mission. Since receipt of that TWX, the following actions have been accomplished:

a. Chains of command of the various APG organizations involved with the mission have been personally briefed on mission requirements and necessary administrative needs.

b. A list of personnel has been approved to support the mission. This list includes four personnel from BRL, four from various organizations within the Ordnance School, three from CSTA, and one from HEL. This list has been forwarded to AMC and appointments have been made to begin the Desert Shield Preparation for Overseas Reassignment (POR) on Monday, 17 December.

c. All personnel will be attached to BRL once the order to move is received. BRL will then cut the TDY orders for all personnel. These orders have, in fact, been completed as they are required for the POR. Personnel will remain with their parent units until such time as the movement order is received. It is anticipated they will then have 48 hours to report for deployment. It is felt that in this way, there will be minimum turbulence at the parent units given the nature of the orders. AMC Deployment packages have also been received for all personnel.

d. Initial coordination has been made through LABCOT to AMC to organize incountry logistical support. This coordination is currently ongoing. The POC for this coordination at AMC is LTC Dennis Schmidt of the AMC Desert Shield Office.

e. The funding of this effort is being addressed by Mr. D. Ore. However, it does not look like any plans have yet been made by any agency to cover TDY or training expenses.

f. A training plan is being developed to train team members on the mission essentials. Initial draft of this plan is expected Monday, 17 December. Additional training will also be handled during the POR process.

g. Mission checklists, supply requirements, and various personnel actions are ongoing. Interviews with personnel having previous experience from earlier conflicts have also been conducted. An initial in-brief for all team members is scheduled for Friday, 14 December at 1400. At that time, all members will receive copies of their orders, the deployment packets, and a review of mission requirements and expectations.

SLCBR-VL-S

SUBJECT: Desert Shield Support

2. Currently, the most critical area of concern is the logistical support (e.g. billets, mess, chain of command, transportation, etc.) which will be necessary once the team is deployed. Initial communication with the tasking organization (HQ-DAMO-FD) has provided no assistance nor guidance. The specifics of transportation to Desert Shield is also a concern. It is anticipated that these issues will be addressed by the AMC Desert Shield Office.

3. Point of contact for this action is Major Dick Koffinke, 3-6293.

JOHN R. JACOBSON
Chief, Systems Assessment Branch

CF:

Deputy Director/Commander BRL
Chief, VLD
Chief, SECAD

SLCBR-VL-S (70-1y)

10 January 1991

MEMORANDUM FOR Director, U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground, MD 21005-5066

SUBJECT: Desert Shield Support Update

1. References:

a. TWX, HQDA, DAMO-FD, 6 December 1990, subject: Desert Shield Armored Vehicle Battle Damage Assessment.

b. Memorandum, USABRL, SLCBR-VL-S, 13 December 1990, subject: Desert Shield Support.

2. Reference a. assigned a mission to BRL in support of Operation Desert Shield. Reference b. was the first update of actions taken to support this mission's accomplishments. This memorandum is another update on mission preparations.

3. The following actions have been taken since the 13 December update:

a. Processing for overseas reassignment for all personnel was completed on 20 December. Four personnel from BRL, four personnel from the Ordnance School, three personnel from CSTA, and one from HEL completed processing for subsequent assignment to this team.

b. Training has been conducted in two phases. Phase 1 involved the familiarization training of all personnel on the Abrams tank, the Bradley Fighting Vehicle, the Sheridan Amphibious Assault Vehicle, and the USMC LAV-25. Phase 2 was the damage assessment training which consisted of armor and armor penetrator classes, live fire testing familiarization classes, review of previous live fire damage assessment reports and videos, photography classes, and actual damage assessment tasks. Due to weather and resource availability, not all of the damage assessment training is yet completed, but is scheduled to be finished NLT 14 January.

c. Damage assessment checklists have been developed and are being formatted for subsequent input into the Information Collection and Reporting System (ICARS). By using this system, checklists which have been completed by team members can be mailed back to BRL, along with the rolls of undeveloped film, and can then be immediately entered into the vulnerability data base already established here to support the Joint Live Fire and Live Fire test programs.

d. Orders attaching team members to BRL have been cut but are currently undated. If needed, a notification system is in place to allow these orders to be forwarded and dated within a matter of minutes to insure quick final processing. All personnel are also receiving evaluation reports which will be

SLCBR-VL-S

SUBJECT: Desert Shield Support Update

undated. These reports are required due to the possibility of extended TDY. Additional personnel actions have been prepared (separate rations, additional pay, etc.) and will be executed when and if required.

e. Requisitions for supplies have been prepared and forwarded. Some supply items have already been fabricated by BRL shops, and all camera equipment has been purchased. "Hard card" requests for supply items need to be expedited, and local purchase actions still need to be done. Team members have not yet had the opportunity to address these issues.

f. Ft. Knox responded to the original tasking and asked how they could support. A deficiency in Bradley-qualified personnel was discussed and a request to fill this void (one officer and one NCO Master Gunner) was forwarded to Ft. Knox for evaluation. Discussions were then held with representatives of the Directorate of Personnel at Ft. Knox and it was learned that Bradley personnel were critically short, but that if TRADOC was brought on line to task Knox, somehow the slots would have to be filled. It was decided that the need was not critical enough, given Ft. Knox's other missions, to continue with further efforts to get Bradley personnel.

4. As in the last update, the most critical area of concern is the logistical support (e.g. billets, mess, chain of command, transportation, etc.) which will be necessary once the team is deployed. Initial communication with the tasking organization (HQ-DAMO-FD) has provided no assistance nor guidance, except that a 48-hour mission response time will be authorized once notification is received. Requests for assistance passed through LABCOT and AMC as of yet have shown no results down to this level. No theater clearance has been received nor is it known if it has been requested. It was learned today, however, that a representative of DAMO-FD was working on this issue. The LABCOT Desert Shield office (Mr. S. Montgomery) is attempting to find out the status of the clearance issue by working through the AMC Readiness Office (MG Arwood).

5. Point of contact for this action is Major Dick Koffinke, 3-6293.

JOHN R. JACOBSON
Chief, Systems Assessment Branch

CF:

Deputy Director/Commander BRL
Chief, VLD
Chief, SECAD
Chief, Live Fire Office, U.S. Army Test and Evaluation Command

SLCBR-VL-S (70-1y)

18 January 1991

MEMORANDUM FOR Director, U.S. Army Ballistic Research Laboratory, Aberdeen Proving Ground, MD 21005-5066

SUBJECT: Desert Shield Support Final Update

1. References:

a. TWX, HQDA, DAMO-FD, 6 December 1990, subject: Desert Shield Armored Vehicle Battle Damage Assessment.

b. Memorandum, USABRL, SLCBR-VL-S, 13 December 1990, subject: Desert Shield Support.

c. Memorandum, USABRL, SLCBR-VL-S, 10 January 1991, subject: Desert Shield Support Update.

2. Reference a. assigned a mission to BRL in support of Operation Desert Shield. Reference b. and c. were updates of actions taken to support this mission's accomplishments. This memorandum is the final report on mission preparations.

3. The following actions have been taken since the 10 January update:

a. All training and security program read-ons have been accomplished.

b. The team was notified for deployment at 2145, 16 January. At that time, logistical support issues, previously addressed had not been resolved. The team was ordered to proceed to Dover for deployment ASAP.

c. The team was assembled with all equipment 0600, 17 January. Supply and administrative issues were resolved only with the outstanding support of many BRL personnel. Except for the issue of personal weapons, the team was prepared for departure at 1530, 17 January, approximately 18 hours after notification. At 1600, it was learned that the team would initially report to the AMC (FWD) Detachment Commander once in-country, and would then be passed on to ARCENT control for further deployment.

d. Two days prior to deployment notification, it was decided that even without guidance for logistical support, it would be in the team's best interest to make arrangements for personal weapons. The initial coordination was done, however, once the notification was given and an attempt was made to draw the weapons, improper administrative actions held up the actual weapon draw. AMC Emergency Operations Center (COL Griggs) had to be notified to contact TECOM to pass down the authorization to allow the weapons issue. This was accomplished and 11 weapons were signed over to the BRL property book officer. Due to the condition of the weapons, it was decided to test fire them. Only 4 of the 11 weapons functioned properly.

SLCBR-VL-S

SUBJECT: Desert Shield Support Final Update

e. Due to the personal initiative taken by members of the Ordnance School, arrangements were made to draw weapons from the 610th Ordnance Battalion at Ft. Belvoir. This was accomplished at 1400 on 18 January. The weapons were test fired at Range 10 and found to be fully functional.

f. The team departed for Dover at approximately 1800, 18 January for subsequent deployment.

5. Point of contact for this action is Major Dick Koffinke, somewhere supporting Operation Desert Storm.

JOHN R. JACOBSON
Chief, Systems Assessment Branch

CF:

Deputy Director/Commander BRL
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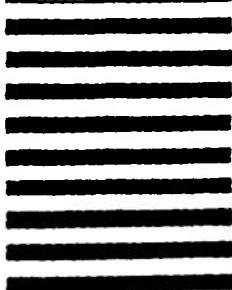
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